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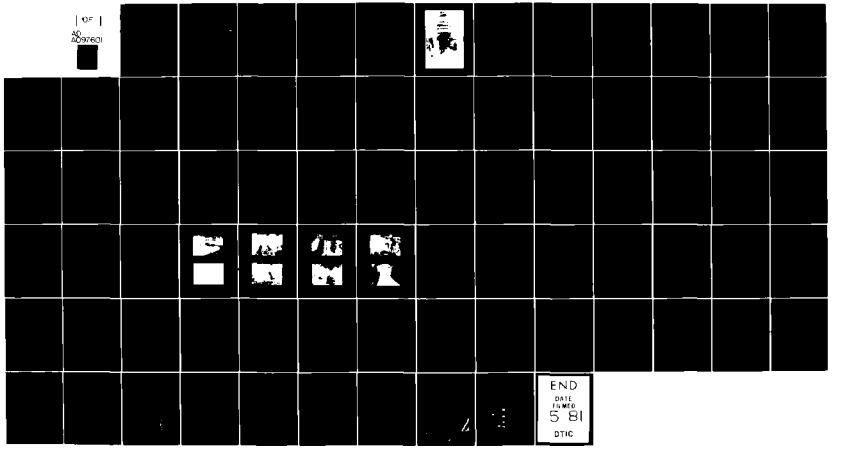

SUSQUEHANNA RIVER BASIN

MARTINS CREEK, SUSQUEHANNA COUNTY

PENNSYLVANIA

LOWER ALFORD LAKE DAM

NDI No. PA 00053

PennDER No. 58-47

Dam Owners: William Deininger, David Deininger

Louis Fortuna, John Fortuna

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

DACW 31-81-C-0011

prepared for

DEPARTMENT OF THE ARMY

Baltimore District, Corps of Engineers

Baltimore, Maryland 21203

prepared by

MICHAEL BAKER, JR., INC.

Consulting Engineers

4301 Dutch Ridge Road

Beaver, Pennsylvania 15009

February 1981

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SUSQUEHANNA RIVER BASIN

LOWER ALFORD DAM
SUSQUEHANNA COUNTY, COMMONWEALTH OF PENNSYLVANIA
NDI No. PA 00053
PennDER No. 58-47

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION PROGRAM

Prepared for: DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

Prepared by: MICHAEL BAKER, JR., INC.
Consulting Engineers
4301 Dutch Ridge Road
Beaver, Pennsylvania 15009

February, 1981

PREFACE

This report is prepared under guidance contained in the "Recommended Guidelines for Safety Inspection of Dams," for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses invclving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I Inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Lower Alford Dam, Susquehanna County, Pennsylvania
NDI No. PA 00053, PennDER No. 58-47
Martins Creek
Inspected 30 October 1980

ASSESSMENT OF GENERAL CONDITIONS

Lower Alford Dam is owned by William Deininger, David Deininger, Louis Fortuna, and John Fortuna. Lower Alford Dam is classified as a "High" hazard - "Small" size dam. The dam was found to be in good overall condition at the time of inspection.

Hydraulic/hydrologic evaluations, performed in accordance with procedures established by the Baltimore District, Corps of Engineers, for Phase I Inspection Reports, revealed that the spillway will pass approximately 3.5 ~~percent~~ of the Probable Maximum Flood (PMF) before overtopping will occur. A spillway design flood (SDF) in the range of the 1/2 Probable Maximum Flood (1/2 PMF) to the PMF is required for Lower Alford Dam. The 1/2 PMF was chosen for the SDF as the dam is on the low end of the "Small" size category. Because the total duration and maximum depth of overtopping under the 1/2 PMF (20.50 hours and 4.17 feet, respectively) exceeds the limiting criteria estimated for failure of the dam (5 hours and 4.0 feet), it was determined that dam failure is likely under 1/2 PMF conditions. Further analyses indicated that the downstream damages would increase significantly as a result of failure of the dam. The spillway is therefore considered "Seriously Inadequate." The owners should immediately initiate an engineering study to further evaluate the spillway capacity and to develop recommendations for remedial measures to reduce the overtopping potential of the dam.

In summary, Lower Alford Dam is classified as being in an "Unsafe" - "Non-emergency" condition because of the results of the hydraulic/hydrologic evaluations.

The inspection and review of information revealed certain items of work which should be performed immediately by the owners. Item 1 below should be designed and completed under the guidance of a qualified professional engineer experienced in the design of hydraulic structures for dams.

1) Initiate an engineering study to further evaluate the spillway capacity in order to develop recommendations for remedial measures to reduce the overtopping potential of the dam.

2) Cut the brush and trees located on the right downstream face of the dam.

3) Remove the debris and cut the vegetation in the downstream channel.

4) Provide means to draw down reservoir during an emergency.

In addition, the following operational measures are recommended to be undertaken by the owners:

1) Develop a detailed emergency operation and warning system.

2) During periods of unusually heavy rain, provide around-the-clock surveillance of the dam.

3) When warning of a storm of major proportions is given by the National Weather Service, activate the emergency operation and warning system.

It is further recommended that formal inspection, maintenance, and operation procedures and records be developed and implemented. An emergency drawdown plan should be developed in case emergency drawdown of the reservoir should become necessary. These should be included in a formal maintenance and operations manual for the dam.

Submitted by:

MICHAEL BAKER, JR., INC.

John A. Dziubek, P.E.
Engineering Manager-Geotechnical

Date: 19 February 1981

Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

JAMES W. PECK
COL, Corps of Engineers
District Engineer
Date: 13 MAR 81

LOWER ALFORD DAM

Overall View of Dam from Left Abutment

TABLE OF CONTENTS

	Page
Section 1 - Project Information	1
Section 2 - Engineering Data	5
Section 3 - Visual Inspection	6
Section 4 - Operational Procedures	7
Section 5 - Hydraulic/Hydrologic	8
Section 6 - Structural Stability	10
Section 7 - Assessment, Recommendations/Remedial Measures	11

APPENDICES

Appendix A - Visual Inspection Check List, Field Sketch, Top of Dam Profile, and Typical Cross-Section
Appendix B - Engineering Data Check List
Appendix C - Photograph Location Plan and Photographs
Appendix D - Hydrologic and Hydraulic Computations
Appendix E - Plates
Appendix F - Regional Geology

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
LOWER ALFORD DAM
NDI No. PA 00053, PennDER No. 58-47

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority - The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose of Inspection - The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances - Lower Alford Dam consists of an earthfill embankment with dry stone masonry walls for the upstream and downstream slopes. The dam is approximately 120 feet long and 14.5 feet high, with a crest width of 15 feet.

The spillway consists of a concrete broad crested weir located at the left abutment of the dam. The spillway length is 48.5 feet perpendicular to the direction of flow with stone training walls rising approximately 1 foot above the crest of the spillway. The flow then falls approximately 14 feet into a stone-lined plunge pool.

Two abandoned tailrace structures, 3 ft. by 3 ft. and 7 in. by 10 in. stone conduits, are located to the right of the spillway. They are sealed off at the upstream side.

b. Location - Lower Alford Dam is located on Martins Creek, 3.4 miles north-northwest of Kingsley, in Harford Township, Susquehanna County, Pennsylvania. The coordinates of the dam are N 41° 48.4', W 75° 46.4'. The dam is located on USGS 7.5 minute topographic quadrangle, Montrose East, Pennsylvania

c. Size Classification - The height of the dam is 14.5 feet. Storage at the top of the dam [Elevation 1035.6 ft. M.S.L.] is 315 acre-feet. The dam is therefore in the "Small" size category.

d. Hazard Classification - Loss of life could occur from a failure of the dam since two residential structures are located within 1,000 feet downstream. Therefore, Lower Alford Dam is considered in the "High" hazard category.

e. Ownership - The dam is owned jointly by four people. They are:

William Deininger
Box 294
RD 3
Ranson Road
Clarks Summit, PA 18411

David Deininger
101 Billy Lane
Taylor, PA

Louis Fortuna
433 Whales Street
Scranton, PA

John Fortuna
501 Powell Street
Taylor, PA

f. Purpose of Dam - The impoundment created by the dam was originally used for water power but is now used for recreational purposes.

g. Design and Construction History - It could not be determined who the contractor or engineer was or when the dam was constructed. The earliest available records of the dam date back to 1919.

h. Normal Operational Procedures - The reservoir is typically maintained at the spillway crest (Elevation 1034.0 ft. M.S.L.). The owner visits the dam at least once a week and more frequently in the warmer months.

1.3 PERTINENT DATA

a. Drainage Area (square miles) - 5.34

b. Discharge at Dam Site (c.f.s.) -

Maximum Flood - Unknown

Spillway Capacity (at Pool El. 1035.6 ft. M.S.L.) -	250

c. Elevation (feet above Mean Sea Level [M.S.L.])* -

Design Top of Dam -	Unknown
Minimum Top of Dam -	1035.6
Maximum Design Pool -	Unknown
Spillway Crest -	1034.0
Streambed at Toe of Dam -	1021.1
Maximum Tailwater of Record -	Unknown

d. Reservoir (feet) -

Length of Normal Pool (El. 1034.0 ft. M.S.L.) -	6350
Length of Maximum Pool (El. 1035.6 ft. M.S.L.) -	6700

e. Storage (acre-feet) -

Top of Dam (El. 1035.6 ft. M.S.L.) -	315
Normal Pool (El. 1034.0 ft. M.S.L.) -	260

f. Reservoir Surface (acres) -

Normal Pool (El. 1034.0 ft. M.S.L.) -	34
Maximum Pool (El. 1035.6 ft. M.S.L.) -	38

g. Dam -

Type - Earthfill with dry stone masonry walls	
Total Length (feet) -	120
Height (feet) - Design -	Unknown
Field -	14.5
Top Width (feet) -	15
Side Slopes - Upstream -	Vertical
Downstream -	Vertical
Zoning -	None
Impervious Core -	None
Cut-off -	None
Drains -	None

h. Diversion and Regulating Tunnel - None

*All elevations are referenced to the spillway crest of the dam, El. 1034.0 ft. M.S.L. as estimated from the USGS 7.5 minute topographic quadrangle, Montrose East, Pennsylvania.

i. Spillway -

Type - Concrete broad crested	
Location - At left abutment	
Length of Crest Perpendicular to Flow (feet) -	48.5
Width of Crest Parallel to Flow (feet) -	10
Crest Elevation (ft. M.S.L.) -	1034.0
Gates -	None
Downstream Channel -	Natural streambed; a stone pier and remnants of an old mill are located in the channel approximately 200 feet downstream from the dam.

j. Outlet Works - Two abandoned tailrace structures, 3 ft. by 3 ft. and 7 in. by 10 in. stone conduits, are both sealed off at the upstream side. These structures apparently supplied water to the abandoned mill downstream from the dam. There are no other outlet works.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

The information reviewed consisted of File No. 58-47 of the Pennsylvania Department of Environmental Resources (PennDER). This file contained a copy of the following information:

1) The first dam inspection report on Lower Alford Dam, dated 28 August 1919.

2) The latest dam inspection report on Lower Alford Dam, dated 22 October 1964. The dam was reported to be in good condition at that time. No information is available concerning the design or construction of the dam.

3) Other inspection reports performed between the 1919 and 1964 inspections.

2.2 CONSTRUCTION

The information reviewed consisted of File No. 58-47 of the Pennsylvania Department of Environmental Resources (PennDER). The file contained no information concerning construction of the dam.

2.3 OPERATION

The owners of the dam are responsible for all operations and maintenance.

2.4 EVALUATION

a. Availability - The information used is readily available from PennDER File No. 58-47.

b. Adequacy - The information available is adequate for Phase I Inspection of this dam.

c. Validity - There is no reason at the present time to doubt the validity of the available engineering data.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General - The dam was found to be in good overall condition at the time of inspection on 30 October 1980. No unusual weather conditions were experienced during the inspection. Noteworthy deficiencies observed during the visual inspection of the dam are described briefly in the following paragraphs. The complete visual inspection check list, field sketch, top of dam profile, and typical cross-section are presented in Appendix A.

b. Dam - Some trees and brush were observed on the right downstream face of the dam. These should be cut.

c. Appurtenant Structures - The spillway crest is slightly irregular, however, this should not significantly affect the performance of the spillway.

d. Reservoir Area - The reservoir area has steep slopes which are densely forested. However, the slope of Martins Creek, the main tributary to Lower Alford Dam, is mild to moderate. The creek passes through several marshes before it reaches Lower Alford Dam. There is also a small dam, Upper Alford Dam, and several large masonry culverts under railroad embankments, through which Martins Creek passes in the upper portions of the watershed. Neither the upstream dam nor the masonry culverts is judged to have a significant effect on Lower Alford Dam.

e. Downstream Channel - The downstream channel is moderately sloped. There are some large trees and debris in the channel. The channel is partially obstructed by an old mill located 200 feet downstream of the dam. There is an average of 4 feet of clearance between the channel invert and the bottom of the mill. Located 500 and 1,000 feet downstream of the dam are a trailer and house, respectively, which may suffer economic damage and possible loss of lives in these structures in the event of failure of the dam.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no formal procedures for lowering the reservoir or evacuating the downstream area in case of an impending failure of the dam. It is recommended that formal emergency procedures be adopted, prominently displayed, and furnished to all operating personnel.

4.2 MAINTENANCE OF DAM

Generally, the maintenance procedures followed are adequate; however, a more conscientious and formal maintenance program and procedures should be developed.

4.3 MAINTENANCE OF OPERATING FACILITIES

Maintenance is performed on an as-needed basis. It is recommended that a formal operation and preventive maintenance schedule be developed and implemented. An emergency drawdown plan should be developed in case emergency drawdown of the reservoir should become necessary.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system in the event of a dam failure. An emergency warning system should be developed.

4.5 EVALUATION OF OPERATIONAL ADEQUACY

The current operational features are adequate for the purpose they serve. However, it is recommended that a formal maintenance and operations manual be prepared for the dam.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data - No hydrologic or hydraulic design calculations are available for Lower Alford Dam.

b. Experience Data - No information concerning the effects of significant floods on the dam is available.

c. Visual Observation - This is a masonry dam with a concrete cap on the spillway. The minimum top of dam elevation is 1035.6 feet which gives a freeboard of 1.6 feet. The spillway crest is irregular, being low (1034.0 feet) in the center and higher on each end with an average crest elevation of 1034.2 feet. During the visual inspection, no problems were observed which would indicate that the dam and appurtenant facilities could not perform satisfactorily during a flood event.

d. Overtopping Potential - Lower Alford Dam is a "Small" size -"High" hazard dam requiring evaluation for a spillway design flood (SDF) in the range of 1/2 Probable Maximum Flood (1/2 PMF) to the Probable Maximum Flood (PMF). Due to the small size of the impoundment, the 1/2 PMF was chosen as the SDF.

The hydraulic capacity of the dam, reservoir, and spillway was assessed by utilizing the U.S. Army Corps of Engineers' Flood Hydrograph Package, HEC-1 DB. The hydrologic characteristics of the basin, specifically, the Snyder's unit hydrograph parameters, were obtained from a regionalized analysis conducted by the Baltimore District of the U.S. Army Corps of Engineers.

Analysis of the dam and spillway shows that during the SDF, the dam will be overtopped by a maximum depth of 4.17 feet for a duration of 20.50 hours.

The spillway is capable of passing only 3.5 percent of the PMF before overtopping occurs.

e. Spillway Adequacy - As outlined in the above analyses, the spillway cannot pass the SDF before overtopping occurs. The next criteria for determining spillway adequacy requires an estimate of whether the dam will fail during the 1/2 PMF. The following conditions, as well as the overall state

of the dam, were estimated as the limiting criteria which are likely to cause failure of the dam.

1) Depth of overtopping of 4.0 feet or greater.

2) Duration of overtopping in excess of 5 hours.

Both of these criteria are exceeded during the 1/2 PMF, indicating the dam is likely to fail. To assess the impact of the dam's failure on the damage centers downstream, the 1/2 PMF was routed through the dam for failure and non-failure cases. This analysis indicated that there would be a significant increase in flow magnitude and depth in the downstream damage centers from the non-failure to the failure case. It is likely that there would be a significant increase in downstream damages accompanying this increase in flow which would place this spillway in the "Seriously Inadequate" category.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations - There were no structural inadequacies noted during the visual inspection that cause concern for the structural stability of the dam.

b. Design and Construction Data - No design or construction data were available for review. Generally, for this type of dam, if the ratio of the width of the stonewall portion of the dam is greater than 0.5 times the height of the dam (0.5 w/h), then stability of the dam due to overturning or sliding is not a problem. (Reference: "Evaluation and Repair of Stonewall-earth Dams," by Kent A. Healy, Proceedings of "Safety of Small Dams" conference, New England College, Henniker, New Hampshire, August 4-9, 1974, pp. 149-178). The w/h ratio for this dam is approximately one and no signs of instability were observed during the visual inspection, therefore, further assessments of the structural stability are not considered necessary.

c. Operating Records - No operating records are available.

d. Post-Construction Changes - No changes adversely affecting the structural stability of the dam have been performed.

e. Seismic Stability - The dam is located in Seismic Zone 1 of the "Seismic Zone Map of the Contiguous United States," Figure 1, page D-30, "Recommended Guidelines for Safety Inspection of Dams." This is a zone of minor seismic activity. Therefore, further consideration of the seismic stability is not warranted.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety - Lower Alford Dam was found to be in good overall condition at the time of inspection. Lower Alford Dam is a "High" hazard - "Small" size dam requiring evaluation for an SDF in the range of the 1/2 PMF to PMF. Because of the small size of the impoundment, the 1/2 PMF was chosen as the SDF. As presented in Section 5, the spillway and reservoir were determined to have a capacity of only 3.5 percent of the PMF before overtopping of the dam will occur. During the 1/2 PMF, the maximum depth and total duration of overtopping are 4.17 feet and 20.50 hours, respectively. These exceed the limiting criteria for failure of 4.0 feet or greater maximum depth of overtopping and a total duration in excess of 5 hours estimated for this dam. Therefore, it was concluded that failure of the dam is likely to occur during the 1/2 PMF event. Further, the 1/2 PMF was routed downstream for failure and non-failure cases, and it was determined that failure would significantly increase the damages downstream. The spillway is therefore classified as "Seriously Inadequate" and the dam is assessed as being in an "Unsafe" - "Non-emergency" condition.

b. Adequacy of Information - The information available and the measurements and observations made during the visual inspection are considered sufficient for this Phase I Inspection Report.

c. Urgency - The owner should immediately initiate the further investigation as discussed in paragraph 7.1.d.

d. Necessity for Additional Data/Evaluation - The hydraulic/hydrologic analyses performed for this dam has indicated the need for additional spillway capacity. It is recommended that the owners of Lower Alford Dam immediately initiate an engineering study to further evaluate the spillway capacity and to develop recommendations for reducing the overtopping potential of the dam. This study should result in the implementation of the necessary remedial measures.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

The inspection and review of information revealed certain items of work which should be immediately performed by the owners. Item 1 below should be designed and completed under the guidance of a qualified professional engineer experienced in the design of hydraulic structures for dams.

1) Initiate an engineering study to further evaluate the spillway capacity in order to develop recommendations for remedial measures to eliminate the overtopping potential of the dam.

2) Cut the brush and trees located on the right downstream face of the dam.

3) Remove the debris and cut the vegetation in the downstream channel.

4) Provide means to draw down reservoir during an emergency.

In addition, the following operational measures are recommended to be undertaken by the owners:

1) Develop a detailed emergency operation and warning system.

2) During periods of unusually heavy rain, provide around-the-clock surveillance of the dam.

3) When warning of a storm of major proportions is given by the National Weather Service, activate the emergency operation and warning system.

It is further recommended that formal inspection, maintenance, and operation procedures and records be developed and implemented. An emergency drawdown plan should be developed in case an emergency drawdown of the reservoir should become necessary. These should be included in a formal maintenance and operations manual.

APPENDIX A

VISUAL INSPECTION CHECK LIST, FIELD SKETCH, TOP OF DAM PROFILE, AND TYPICAL CROSS-SECTION

Check List
Visual Inspection
Phase 1

Name of Dam Lower Alford Dam County Susquehanna State PA Coordinates Lat. N 41°48.4'

NDI # PA 00053
PennDER # 58-47

Long. W 75°46.4'

Date of Inspection 30 October 1980 Weather Overcast Temperature 40° F.

Pool Elevation at Time of Inspection 1034.2 ft.* M.S.L. Tailwater at Time of Inspection 1021.3 ft.* M.S.L.

*All elevations referenced to the spillway crest of the dam, El. 1034.0 ft. M.S.L. as estimated from the USGS 7.5 minute topographic quadrangle, Montrose East, Pennsylvania.

Inspection Personnel:

Michael Baker, Jr., Inc.:

James G. Ulinski
Wayne D. Lasch
Jeffrey S. Maze

Owner's Representatives:

James G. Ulinski Recorder

MASONRY DAMS

Name of Dam: LOWER ALFORD DAM

NDI # PA 00053

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
LEAKAGE	None observed	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Good condition	
DRAINS	None observed	
WATER PASSAGES	Not Applicable	
VEGETATION	There are some trees and brush on the right downstream face of the dam.	The trees and brush should be cut.
FOUNDATION	No problems observed	

MASONRY DAMS

Name of Dam: LOWER ALFORD DAM

NDI # PA 00053

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	None observed	
STRUCTURAL CRACKING	Not Applicable	
VERTICAL AND HORIZONTAL ALIGNMENT	Good	
MONOLITH JOINTS	Not Applicable	
CONSTRUCTION JOINTS	Not Applicable	

EMBANKMENT - Not Applicable

Name of Dam LOWER ALFORD DAM

NDI # PA 00053

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS		
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE		
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES		

EMBANKMENT - Not Applicable

Name of Dam LOWER ALFORD DAM

NDI # PA 00053

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST		
RIPRAP FAILURES		

EMBANKMENT - Not Applicable

Name of Dam LOWER ALFORD DAM

NDI # PA 00053

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM		
ANY NOTICEABLE SEEPAGE		
STAFF GAGE AND RECORDER		
DRAINS		

OUTLET WORKS

Name of Dam: LOWER ALFORD DAM

NDI # PA 00053

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Not Applicable	
INTAKE STRUCTURE	Intake structure to both conduits sealed shut by owner.	
OUTLET STRUCTURE	Good condition	
OUTLET CHANNEL	Good condition	
EMERGENCY GATE	None observed	

UNGATED SPILLWAY

Name of Dam: LOWER ALFORD DAM

NDI # PA 00053

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Good condition	
APPROACH CHANNEL	Good condition	
DISCHARGE CHANNEL	Good condition	
BRIDGE AND PIERS	None	

GATED SPILLWAY - Not Applicable

Name of Dam: LOWER ALFORD DAM
NDI # PA 00053

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL		
APPROACH CHANNEL		
DISCHARGE CHANNEL		
BRIDGE AND PIERS		
GATES AND OPERATION EQUIPMENT		

INSTRUMENTATION

Name of Dam: LOWER ALFORD DAM
NDI # PA 00053

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None observed	
OBSERVATION WELLS	None observed	
WEIRS	None observed	
PIEZOMETERS	None observed	
OTHER		

RESERVOIR

Name of Dam: LOWER ALFORD DAM

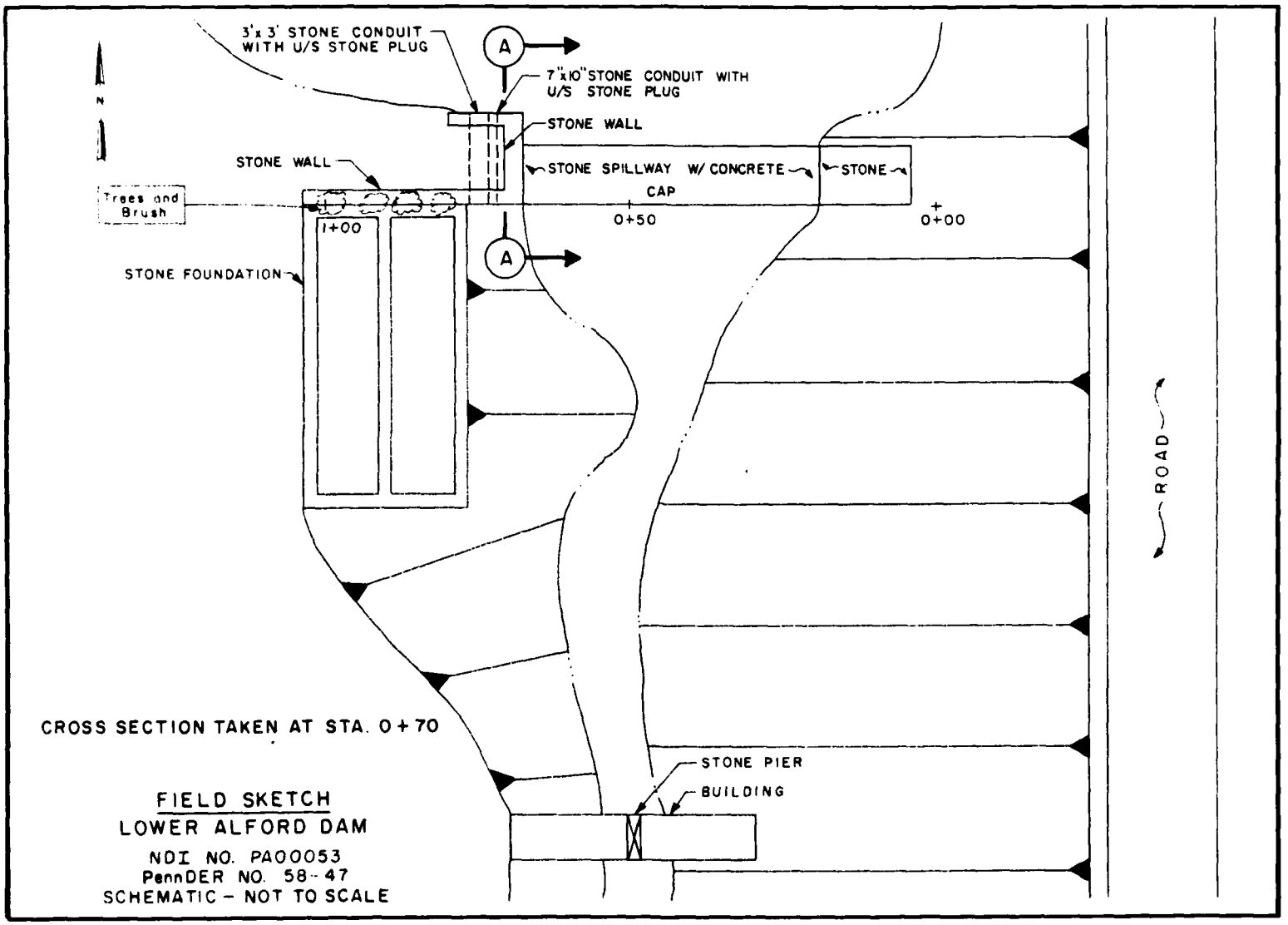
NDI # PA 00053

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Fairly steep to steep with good growth of ground cover and trees.	
SEDIMENTATION	Upper end of reservoir is mostly marshy. Sedimentation in the reservoir is not believed to have a significant affect on the performance of the dam and reservoir during a flood event.	
UPSTREAM DAM	Upper Alford Dam upstream is considered to have insignificant impact on Lower Alford Dam.	

DOWNSTREAM CHANNEL

Name of Dam: LOWER ALFORD DAM
NDI # PA 00053

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	An old mill is located over the channel approximately 200 ft. downstream of the dam. There is an average of 4 ft. of clearance between the channel invert and the soffit of the mill. Both vegetation and debris are in the channel.	Remove debris and cut the vegetation.
SLOPES	The downstream channel is moderately sloped.	
APPROXIMATE NO. OF HOMES AND POPULATION	One trailer and one house may suffer economic damage downstream of the dam. Loss of life may occur in the trailer if the dam should fail.	


3'x 3' STONE CONDUIT WITH U/S STONE PLUG
A
7"x10" STONE CONDUIT WITH U/S STONE PLUG
STONE WALL
STONE WALL
STONE SPILLWAY W/ CONCRETE CAP
STONE
Trees and Brush
1+00
0+50
0+00
A
STONE FOUNDATION
ROAD
CROSS SECTION TAKEN AT STA. 0+70
STONE PIER
BUILDING
FIELD SKETCH
LOWER ALFORD DAM
NDI NO. PA00053
PennDER NO. 58-47
SCHEMATIC – NOT TO SCALE

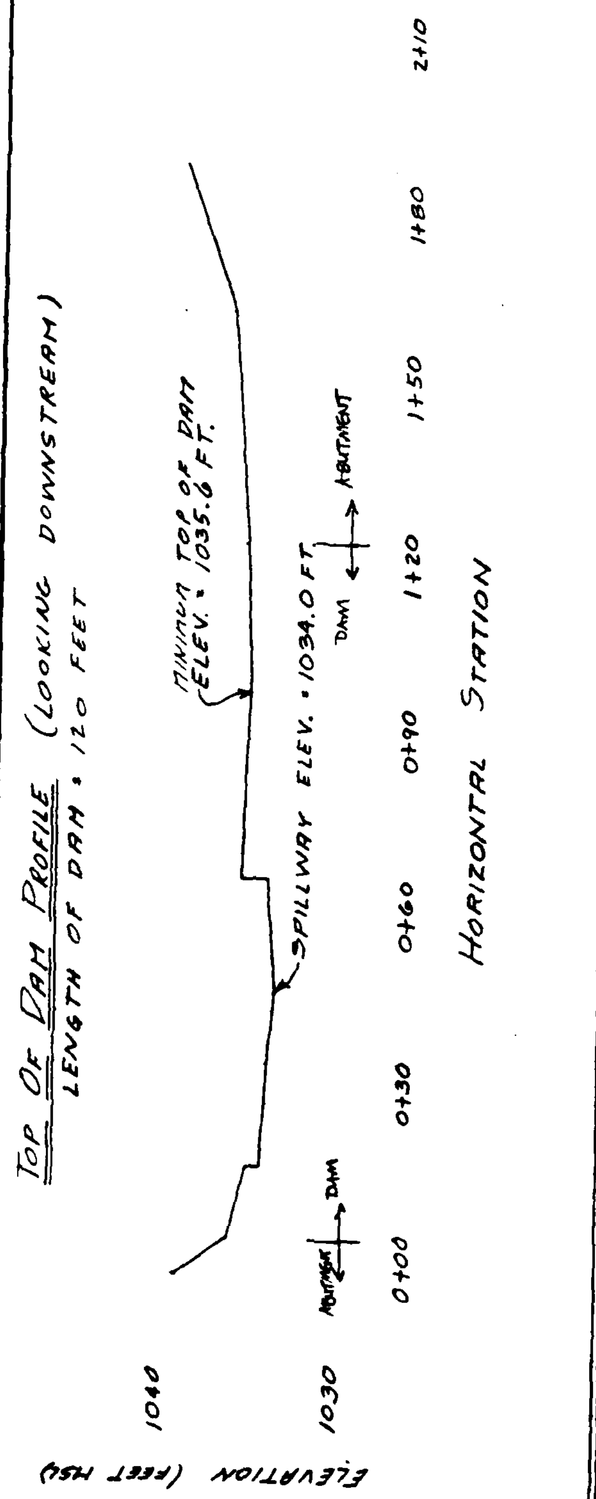
MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

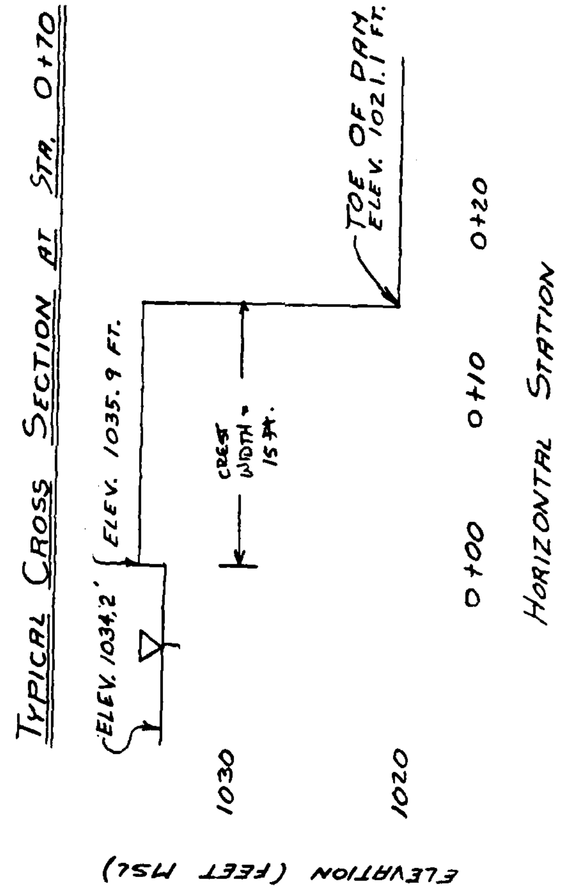
Box 280
Beaver, Pa. 15009

LOWER ALFORD DAM

TOP OF DAM PROFILE
TYPICAL CROSS-SECTION

DATE OF INSPECTION: 27 October 1980





APPENDIX B

ENGINEERING DATA CHECK LIST

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

Name of Dam: LOWER ALFORD DAM
NDI # PA 00053

ITEM	REMARKS
PLAN OF DAM	No information available. See Field Sketch, Plate 3.
REGIONAL VICINITY MAP	A USGS 7.5 minute topographic quadrangle, Montrose East, Pennsylvania, was used to prepare the vicinity map which is enclosed in this report as Plate 1.
CONSTRUCTION HISTORY	No information available
TYPICAL SECTIONS OF DAM	No information available. See typical cross section, Plate 4.
HYDROLOGIC/HYDRAULIC DATA	No information available
OUTLETS - PLAN	No information available
- DETAILS	No information available
- CONSTRAINTS	No information available
- DISCHARGE RATINGS	No information available
RAINFALL/RESERVOIR RECORDS	None

Name of Dam: LOWER ALFORD DAM

NDI # PA 00053

ITEM	REMARKS
DESIGN REPORTS	No information available
GEOLOGY REPORTS	No information was available. The regional geology is presented as Appendix F of this report.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	No information available
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	No information available
POST-CONSTRUCTION SURVEYS OF DAM	None
BORROW SOURCES	No information available

Name of Dam: LOWER ALFORD DAM

NDI # PA 00053

ITEM	REMARKS
MONITORING SYSTEMS	None
MODIFICATIONS	The weir of the dam was replaced with a concrete broadcrested weir in 1980, and the outlet works were plugged by the owner in 1942.
HIGH POOL RECORDS	No information available
POST-CONSTRUCTION ENGINEERING STUDIES AND REPORTS	No detailed engineering reports other than the 28 August 1919 Water Supply Commission Inspection are available. A number of inspection reports are available in the PennDER file, including the latest recorded inspection on 22 October 1964 by PennDER.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None reported in the information available.
MAINTENANCE OPERATION RECORDS	None available

Name of Dam: LOWER ALFORD DAM

NDI # PA 00053

ITEM	REMARKS
SPILLWAY PLAN, SECTIONS, and DETAILS	No information available
OPERATING EQUIPMENT PLANS & DETAILS	None observed

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 5.34 sq.mi., moderate to steep slopes, wooded

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1034.0 ft. M.S.L. (260 ac.-ft.)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 1035.6 ft. M.S.L. (315 ac.-ft.)

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 1035.6 ft. M.S.L. (minimum crest elevation)

SPILLWAY: Rectangular channel with concrete cap

a. Crest Elevation 1034.0 ft. M.S.L.
b. Type Rectangular channel
c. Width of Crest Parallel to Flow 10 ft.
d. Length of Crest Perpendicular to Flow 48.5 ft.
e. Location Spillover Right side of embankment
f. Number and Type of Gates None

OUTLET WORKS: None

a. Type
b. Location
c. Entrance Inverts
d. Exit Inverts
e. Emergency Drawdown Facilities

HYDROMETEOROLOGICAL GAGES: None

a. Type
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE Unknown

APPENDIX C

PHOTOGRAPH LOCATION PLAN AND PHOTOGRAPHS

DETAILED PHOTOGRAPH DESCRIPTIONS

Overall View of Dam from Left Abutment

Photograph Location Plan

Photo 1 - View of Upstream Side of Dam from Right Abutment

Photo 2 - View of Crest of Dam from Right Abutment

Photo 3 - View of Crest of Dam from Left Abutment

Photo 4 - View of Downstream Side of Dam from Right Abutment

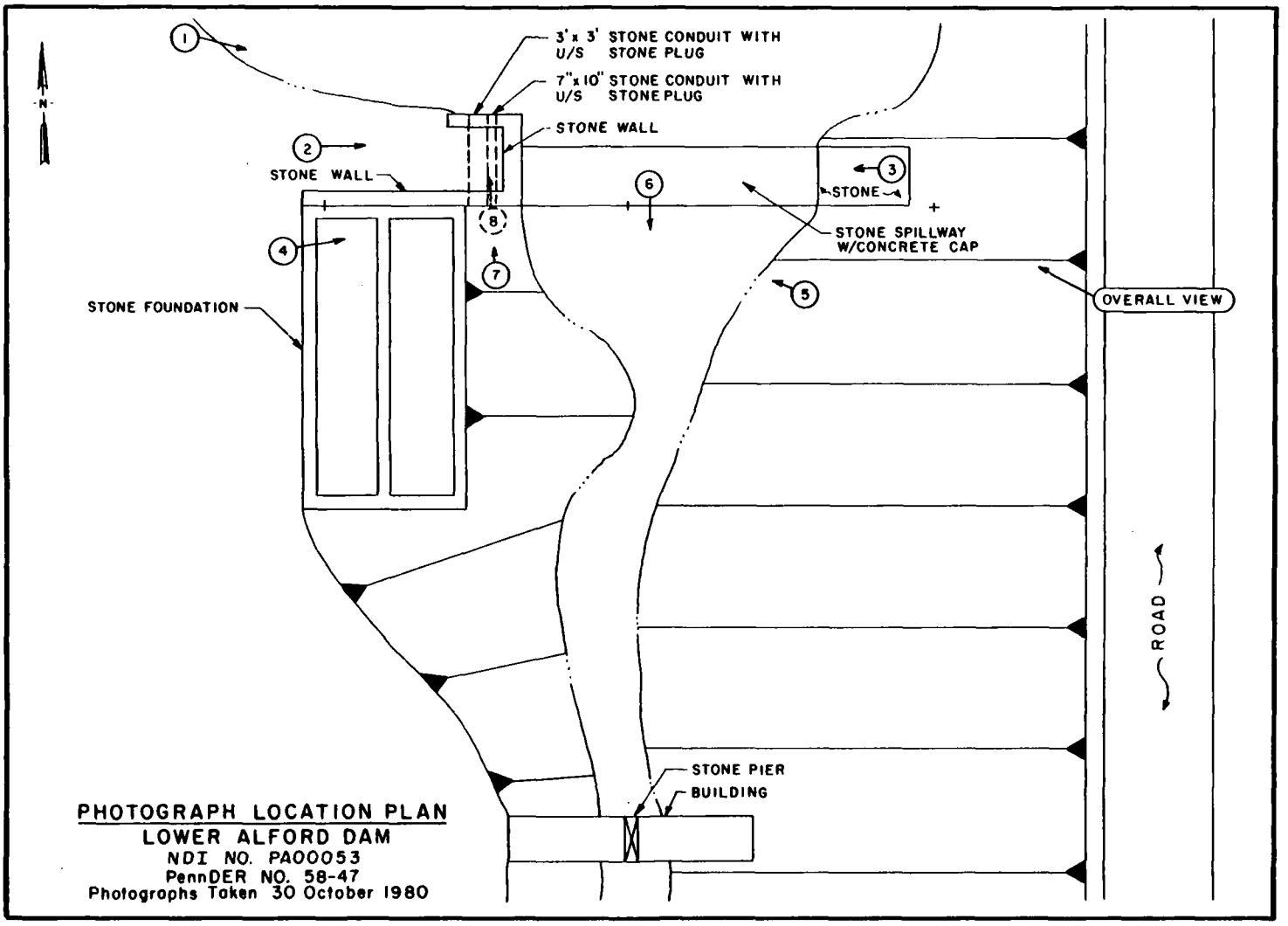
Photo 5 - View of Downstream Side of Dam from Left Abutment

Photo 6 - View of Downstream Channel from Crest of Dam

Photo 7 - View of Abandoned Tailrace Structure

Photo 8 - Inside View of Abandoned Tailrace Structure

Note: Photographs were taken on 30 October 1980.



PHOTOGRAPH LOCATION PLAN
LOWER ALFORD DAM
NDI NO. PA00053
PennDER NO. 58-47
Photographs Taken 30 October 1980

LOWER ALFORD DAM

PHOTO 1. View of Upstream Side of Dam from Right Abutment

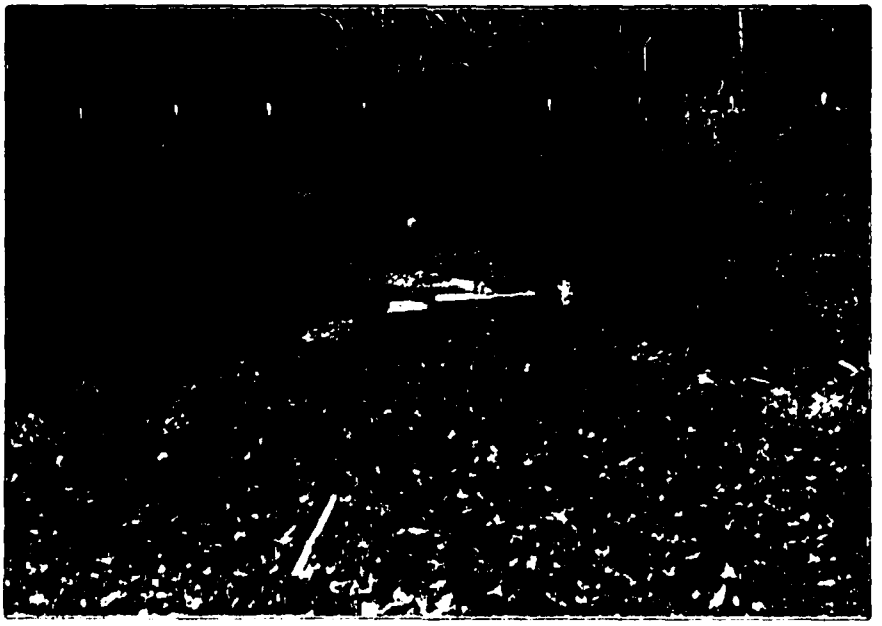


PHOTO 2. View of Crest of Dam from Right Abutment

LOWER ALFORD DAM

PHOTO 3. View of Crest of Dam from Left Abutment

PHOTO 4. View of Downstream Side of Dam from Right Abutment

LOWER ALFORD DAM

PHOTO 5. View of Downstream Side of Dam from Left Abutment

PHOTO 6. View of Downstream Channel from Crest of Dam

PHOTO 7. View of Abandoned Tailrace Structure

PHOTO 8. Inside View of Abandoned Tailrace Structure

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject LOWER ALECIO DAM S.O. No. _____
APPENDIX D - HYDROLOGIC AND Sheet No. _____ of _____
HYDRAULIC COMPUTATIONS Drawing No. _____
Computed by _____ Checked by _____ Date _____

SUBJECT	PAGE
PREFACE	i
HYDROLOGY AND HYDRAULIC DATA BASE	1
HYDRAULIC DATA	2
DRAINAGE AREA AND CENTROID MAP	3
TOP OF DAM PROFILE AND CROSS SECTION	4
SPILLWAY PROFILE AND DISCHARGE RATING	5
SPILLWAY CAPACITY ANALYSIS AND FAILURE ASSUMPTIONS	6
HEC-1 SPILLWAY CAPACITY ANALYSIS	7
HEC-1 DOWNSTREAM ROUTING	12

PREFACE

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

The hydrologic determinations presented in this Phase I Inspection Report are based on the use of a Snyder's unit hydrograph developed by the U.S. Army Corps of Engineers. Due to the limited number of gaging stations available in this hydrologic region and the wide variations of watershed slopes, the Snyder's coefficients may yield results of limited accuracy for this watershed. As directed however, a further refinement of these coefficients is beyond the scope of this Phase I Investigation.

In addition, the conclusions presented pertain to present conditions, and the effect of future development on the hydrology has not been considered.

HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: LOWER ALFORD DAM

PROBABLE MAXIMUM PRECIPITATION (PMP) = 21.0 INCHES/24 HOURS[1]

STATION	1	2	3	4	5
Station Description	LOWER ALFORD DAM				
Drainage Area (square miles)	5.34				
Cumulative Drainage Area (square miles)	5.34				
Adjustment of PMF for Drainage Area (%)[2]	ZONE 1				
6 Hours	111%				
12 Hours	123%				
24 Hours	133%				
48 hours	142%				
72 Hours	--				
Snyder Hydrograph Parameters					
Zone [3]	11				
C_p/C_t [4]	0.62/1.50				
L (miles) [5]	5.72				
L_{ca} (miles)[5]	2.77				
$t_p = C_t (L \cdot L_{ca})^{0.3}$ (hours)	3.44				
Spillway Data					
Crest Length (ft)	48.5				
Freeboard (ft)	1.6				
Discharge Coefficient	(DISCHARGE RATING CURVE DEVELOPED ON SHEET 5)				
Exponent					

[1] Hydrometeorological Report 33 (Figure 1), U.S. Army, Corps of Engineers, 1956.

[2] Hydrometeorological Report 33 (Figure 2), U.S. Army, Corps of Engineers, 1956.

[3] Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's coefficients (C_p and C_t).

[4] Snyder's Coefficients.

[5] L = Length of longest water course from outlet to basin divide.
L_{ca} = Length of water course from outlet to point opposite the centroid of drainage area.

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS
Box 280
Beaver, Pa. 15009

Subject Lower Bleeks Dam — S.O. No.
Hydrologic Data — Sheet No. 2 of 17
Drawing No.
Computed by GMT — Checked by WDL — Date 12-10-00

Storage Calculations

Area vs. Elevation Data: (measured from quad)

Elevation (Ft)	Surface Area (Acres)
1034	33.98
1040	48.67
1060	68.87

Normal Pool Storage

Storage Volume = $V_{NP} = h/3\,(A_1 + A_2 + \sqrt{A_1 A_2})$

h = estimated from field notes = 7.8 Ft.
A_1 = surface area of normal pool = 33.98 Ac.
A_2 = surface area of reservoir bottom = 32.41 Ac.
(estimated from average depth and reservoir side slopes)

Normal Pool Storage: $V_{NP} = 7.8/3\,(33.98 + 32.41 + \sqrt{(33.98)(32.41)})$

$V_{NP} = 258.89$ Ac.-Ft.

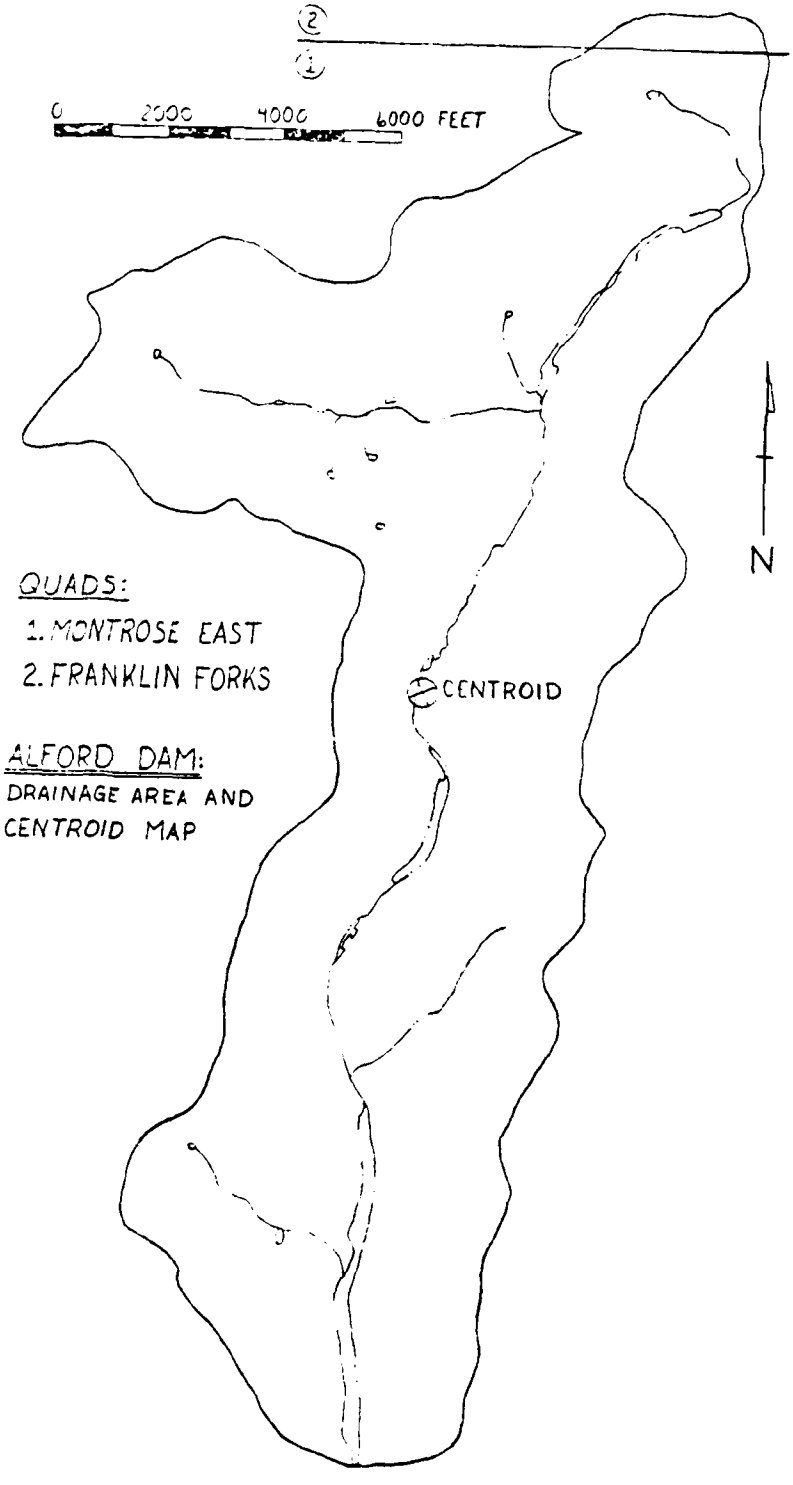
Top of Dam Storage

315 Ac.-Ft. (from HEC-1 analysis)

Snyder's Unit Hydrograph Parameters

$L = 5.72$ Mi., $L_{CA} = 2.77$ Mi.
Watershed is in Zone 11
$C_p = 0.62$ $C_t = 1.50$
$t_p = 1.50\,(L \times L_{CA})^{0.3} = 3.44$ Hr.

Drainage Area = 5.34 Sq. Mi.



QUADS:

1. MONTROSE EAST
2. FRANKLIN FORKS

ALFORD DAM:
DRAINAGE AREA AND CENTROID MAP

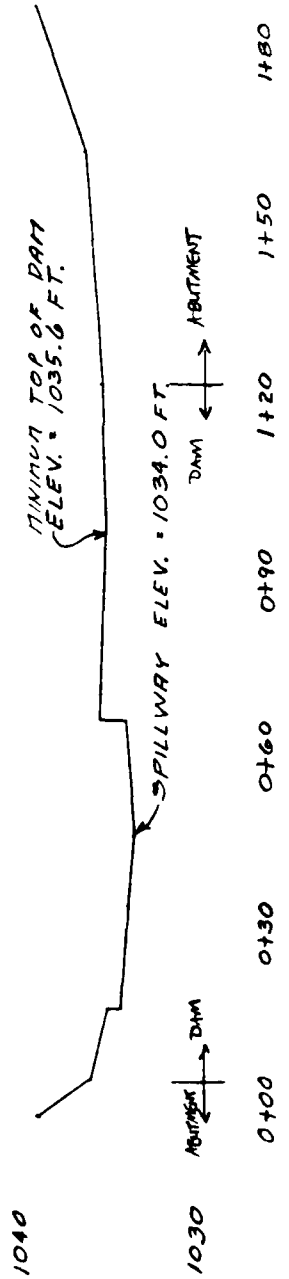
MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

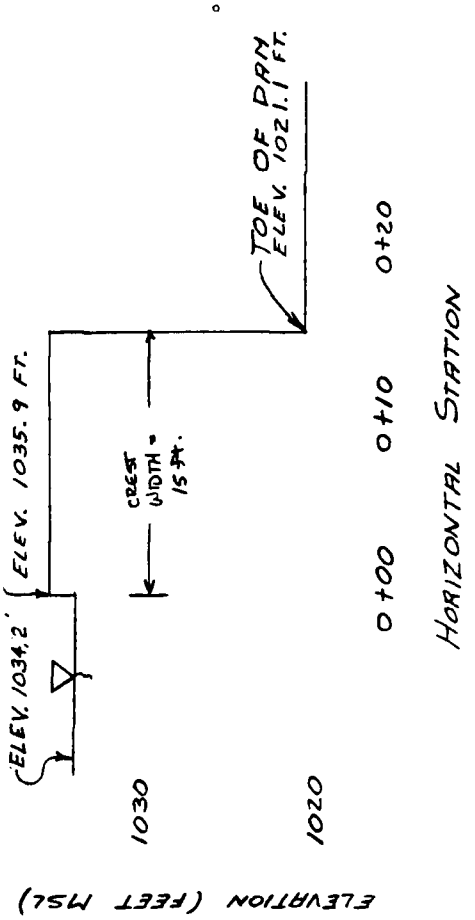
Subject LOWER ALFORD DAM — S.O. No. 13837-00-AAA-06
TOP OF DAM PROFILE — Sheet No. 4 of 17
TYPICAL CROSS SECTION — Drawing No.
Computed by GWT — Checked by WDL — Date 11-17-80

TOP OF DAM PROFILE (LOOKING DOWNSTREAM)

LENGTH OF DAM = 120 FEET



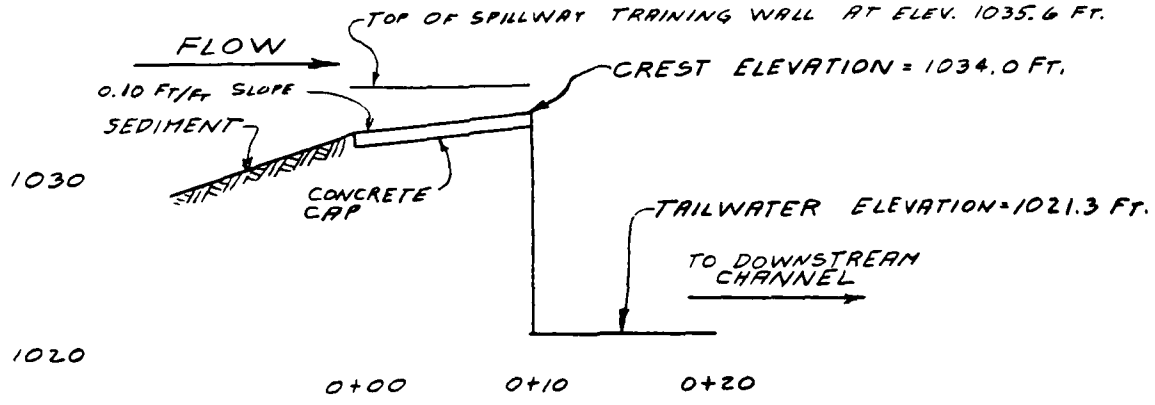
TYPICAL CROSS SECTION AT STA. 0+70



MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS
Box 280
Beaver, Pa. 15009

Subject LOWER ALFORD DAM — S.O. No. 13837-00-ARA-06
SPILLWAY DISCHARGE RATING — Sheet No. 5 of 17
AND SPILLWAY PROFILE — Drawing No.
Computed by GWT — Checked by WDL — Date 11-21-80

SPILLWAY PROFILE



SPILLWAY DISCHARGE RATING

DEVELOP RATING CURVE BASED UPON CRITICAL FLOW OVER SPILLWAY:

$V = \sqrt{gD}$ (CHOW, OPEN CHANNEL HYDRAULICS, P. 43)

$g = 32.2$ FT/SEC^2

D = MEAN HYDRAULIC DEPTH = $\frac{\text{FLOW AREA}}{\text{FREE SURFACE TOP WIDTH}} = \frac{A}{T}$

V = MEAN FLOW VELOCITY

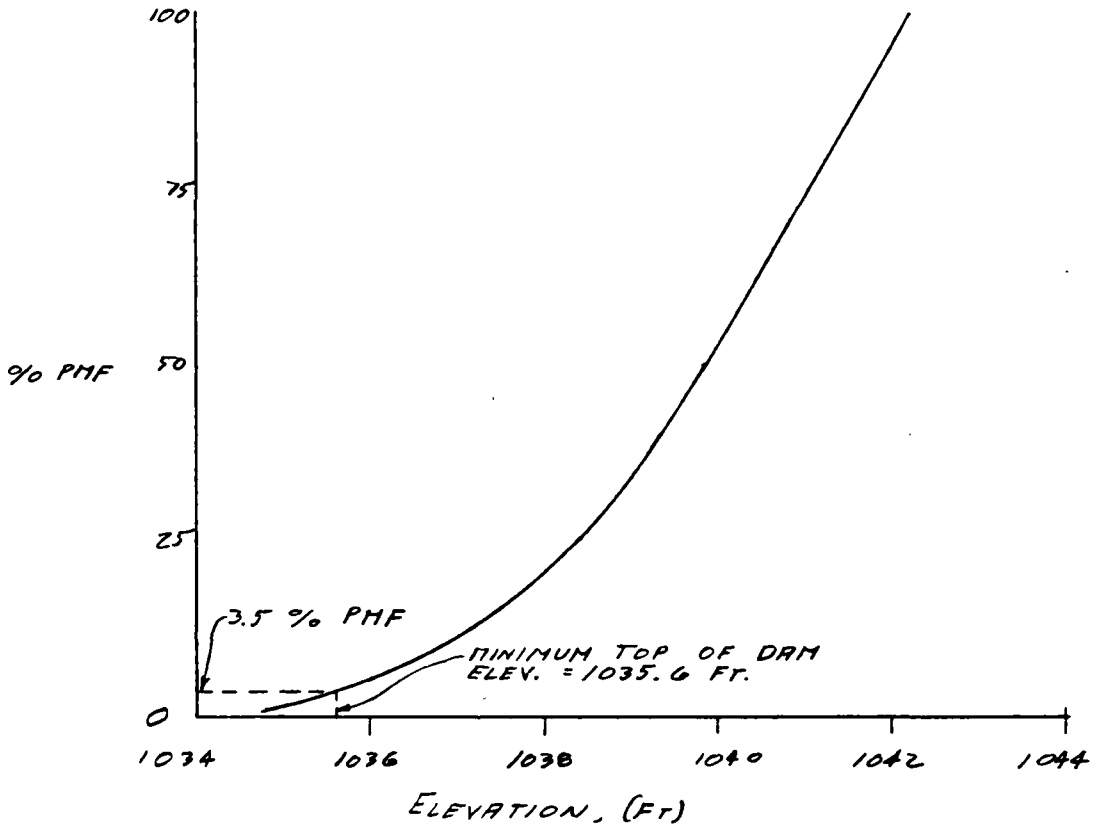
$Q = AV$

SPILLWAY ELEVATION, FT.	FLOW DEPTH FT.	AREA FT^2	TOP WIDTH, FT.	A/T	V, FT/SEC.	Q, CFS	$V^2/2g$	RESERVOIR SURFACE, FT.
1034.0	0	0	0	0	0	0	0	1034.0
1034.5	0.5	10.0	40.0	0.25	2.84	28.37	0.12	1034.62
1034.8	0.8	23.28	48.5	0.48	3.93	91.52	0.24	1035.04
1035.0	1.0	37.83	48.5	0.78	5.01	189.59	0.39	1035.39
1035.5	1.5	62.08	48.5	1.28	6.42	398.55	0.64	1036.14
1035.6	1.6	66.93	48.5	1.38	6.67	446.16	0.69	1036.29
1036.0	2.0	86.33	48.5	1.78	7.57	653.58	0.89	1036.89
1036.5	2.5	110.58	48.5	2.28	8.57	947.48	1.14	1037.64
1037.0	3.0	134.83	48.5	2.78	9.46	1,275.67	1.39	1038.39
1038.0	4.0	183.33	48.5	3.78	11.03	2,022.59	1.89	1039.89
1039.0	5.0	231.83	48.5	4.78	12.41	2,876.15	2.39	1041.39
1040.0	6.0	280.33	48.5	5.78	13.64	3,824.38	2.89	1042.89
1041.0	7.0	328.83	48.5	6.78	14.77	4,858.63	3.39	1044.39

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject LOWER ALFORD DAM S.O. No.
SPILLWAY CAPACITY ANALYSIS Sheet No. 6 of 17
AND FAILURE ASSUMPTIONS Drawing No.
Computed by GWT Checked by WDL Date 12/12/80



FAILURE ASSUMPTIONS:

1. FAILURE TAKES PLACE AS THE DEPTH OF OVERTOPPING NEARS ITS MAXIMUM.
2. THE DAM FAILS ALONG ITS ENTIRE CREST LENGTH.
3. BECAUSE THIS IS A MASONRY DAM THE TOTAL DAM IS ASSUMED TO FAIL. FAILURE WILL OCCUR MODERATELY RAPID. (0.5 HRS. DURATION)
4. FAILURE DEPTH WILL BE TO THE RESERVOIR BOTTOM. (ELEV. 1023.0 Ft ASSUMED.)

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
  MBJ UPDATE         04 JUN 79      SPILLWAY CAPACITY ANALYSIS
**********
    1              A1       NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
    2              A2       HYDROLOGIC AND HYDRAULIC ANALYSIS OF LOWER ALFORD POND DAM
    3              A3       UNIT HYDROGRAPH BY SNYDERS METHOD
    4              B     300        3       30        0        0        0        0        0       -4        0
    5              B1      5
    6              J       1        5        I
    7              J1   1.00     0.50     0.25     0.05     0.01
    8              K       3        1                                              1
    9              K1       RUNOFF HYDROGRAPH TO DAM
   10              M       1        1     5.34
   11              P                21      111      123      133      142
   12              T                                                        1.0     0.05
   13              W    3.44     0.62
   14              X   -1.5     -0.05      2.0
   15              K       1        2                                              1
   16              K1       ROUTING FOR LOWER ALFORD POND DAM
   17              Y                                          1        1
   18              Y1      1                                                =1034.0       =1
   19              Y4   1034   1034.6   1035.0   1035.4   1036.1   1036.3   1036.9   1037.6   1038.4   1039.9
   20              Y41041.4   1042.9   1044.4
   21              Y5      0    28.37     91.5    189.6    398.5    446.2    653.6    947.5   1275.7   2022.6
   22              Y52876.2   3024.4   4858.6
   23              $A 32.41    33.98    48.67    68.87
   24              $E1026.2   1034.2     1040     1060
   25              $$  1034
   26              $01035.6     3.03      1.5      120
   27              $L      0       59       90      112      117      124      128      135
   28              $V1035.0   1036.0   1036.5   1037.0   1037.5   1038.0   1038.5   1039.0
   29              K      99
```

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**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
  MBJ UPDATE         04 JUN 79
**********************************

RUN  DATE 12/02/80
     TIME    13.56
```

NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
HYDROLOGIC AND HYDRAULIC ANALYSIS OF LOWER ALFORD POND DAM
UNIT HYDROGRAPH BY SNYDERS METHOD

JOB SPECIFICATION

NQ	NDR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	30	0	0	0	0	0	-4	0

JUPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 5 LRTIO= 1

RTIOS= 1.00 0.50 0.25 0.05 0.01

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

RUNOFF HYDROGRAPH TO DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	5.34	0.0	5.34	0.0	0.0	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	21.00	111.00	123.00	133.00	142.00	0.0	0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.000

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.0	0.0	1.00	0.0	0.0	1.00	1.00	0.05	0.0	0.0

UNIT HYDROGRAPH DATA
TP= 3.44 CP=0.62 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -0.05 RTIOR= 2.00

UNIT HYDROGRAPH 39 END-OF-PERIOD ORDINATES, LAG= 3.43 HOURS, CP= 0.62 VOL= 1.00

33.	121.	241.	376.	502.	591.	633.	616.	547.	468.
400.	342.	293.	250.	214.	183.	156.	134.	114.	98.
84.	72.	61.	52.	45.	38.	33.	28.	24.	20.
18.	15.	13.	11.	9.	8.	7.	6.	5.	

SHEET 2 of 17

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	23.86	21.48	2.38	151765.
										606.11	546.11	60.11	4297.51

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTING FOR LOWER ALFORD POND DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.0	0.0	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.0	0.0	-1034.	-1

STAGE	1034.00	1034.80	1035.00	1035.40	1036.10	1036.30	1036.90	1037.60	1038.40	1039.90
	1041.40	1042.90	1044.40							
FLOW	0.0	28.37	91.50	189.60	398.50	446.20	653.60	947.50	1275.70	2022.60
	2876.20	3324.40	4858.60							
SURFACE AREA=	32.	34.	49.	69.						
CAPACITY=	0.	266.	504.	1674.						
ELEVATION=	1026.	1034.	1040.	1060.						

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1034.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1035.6	3.1	1.5	120.

CREST LENGTH AT OR BELOW	0.	69.	90.	112.	117.	124.	128.	135.
ELEVATION	1035.0	1035.0	1036.5	1037.0	1037.5	1038.0	1038.5	1039.0

PEAK OUTFLOW IS 9234. AT TIME 43.50 HOURS

PEAK OUTFLOW IS 4605. AT TIME 43.50 HOURS

PEAK OUTFLOW IS 2289. AT TIME 43.50 HOURS

PEAK OUTFLOW IS 413. AT TIME 44.00 HOURS

PEAK OUTFLOW IS 56. AT TIME 46.00 HOURS

********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00	RATIO 2 0.50	RATIO 3 0.25	RATIO 4 0.05	RATIO 5 0.01
HYDROGRAPH AT	1	5.34	1	9332.	4666.	2333.	467.	93.
		13.83)		264.25((	132.12((	66.06((	13.2((	2.64((
ROUTED TO	2	5.34	1	9234.	4605.	2289.	413.	56.
		13.83)		261.49((	130.4((	64.83((	11.69((	1.60((

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1034.00	1034.00	1035.60
STORAGE	259.	259.	315.
OUTFLOW	0.	0.	249.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1042.19	6.59	613.	9234.	27.50	43.50	0.0
0.50	1039.77	4.17	493.	4605.	20.50	43.50	0.0
0.25	1038.19	2.59	420.	2289.	15.00	43.50	0.0
0.05	1035.05	0.45	333.	413.	6.00	44.00	0.0
0.01	1034.78	0.0	286.	56.	0.0	46.00	0.0

Spillway Capacity Analysis

SHEET 11 OF 17

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
  88J UPDATE         04 JUN 79     ANALYSIS OF DAM FAILURE
**********
    1          A1       NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
    2          A2       HYDROLOGIC AND HYDRAULIC ANALYSIS OF LOWER ALFORD POND DAM
    3          A3       UNIT HYDROGRAPH BY SNYDERS METHOD
    4          B     500      0        5        0        0        0        0        0       -4        0
    5          B1      5                                                                                          PLAN 1 - FAILURE
    6          J       2        1        1                                                                        PLAN 2 - NON-FAILURE
    7          J1   0.50
    8          K       3        1                                          1
    9          K1       RUNOFF HYDROGRAPH TO DAM
   10          M       1        1     5.34                                                      1
   11          P                21      111      123      133      142
   12          T                                                          1.0     0.05
   13          W    3.44     0.32
   14          X   -1.5     -0.05     2.0
   15          K       1        2                                          1
   16          K1       ROUTING FOR LOWER ALFORD POND DAM
   17          Y                                         1        1
   18          Y1      1                                                -1034.0     -1
   19          Y4   1034  1034.6   1035.0   1035.4   1036.1   1036.3   1036.9   1037.6   1038.4   1039.9
   20          Y41041.4  1042.9   1044.4
   21          Y5      0    28.37     91.5    189.6    398.5    446.2    653.6    947.5   1275.7   2022.6
   22          Y52876.2  3824.4   4858.6
   23          $A  32.41    33.98    48.67    68.87
   24          $E1026.2  1034.2     1040     1060
   25          $$   1034
   26          $D1035.0     3.38      1.5      120
   27          $L      0       69       90      112      117      124      128      135
   28          $V1035.6  1036.0   1036.5   1037.0   1037.5   1038.0   1038.5   1039.0
   29          $B    120       1     1023      0.5   1034.2   1039.6
   30          $D    120       1     1023      0.5   1034.2     1045
   31          K       1        3                                          1
   32          K1       ROUTE TO SECTION 1200 FEET DOWNSTREAM OF DAM
   33          Y                                         1        1
   34          Y1      1                                                    0
   35          Y6   0.06     0.04     0.06   1013.5     1040     1200   0.0049
   36          Y7      3     1040      105     1020      135     1015      145   1013.5      150   1013.5
   37          Y7    100     1015      190     1020      300     1040
   38          K      99
```

Sheet 12 of 17

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION  26 FEB 79
  MBJ UPDATE         04 JUN 79
**********

RUN  DATE 12/11/80
     TIME    11.15
```

NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
HYDROLOGIC AND HYDRAULIC ANALYSIS OF LOWER ALFORD POND DAM
UNIT HYDROGRAPH BY SNYDERS METHOD

JOB SPECIFICATION

NQ	NRR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
500	3	5	0	0	0	3	0	-4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 2 NRTIO= 1 LRTIO= 1

RTIOS= 0.50

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

RUNOFF HYDROGRAPH TO DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	5.34	0.0	5.34	0.0	0.0	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	21.00	111.00	123.00	133.00	142.00	0.0	0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.0	0.0	1.00	0.0	0.0	1.00	1.00	0.05	0.0	0.0

UNIT HYDROGRAPH DATA

IP= 3.44 CP=0.62 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -0.05 RTIOR= 2.00

UNIT HYDROGRAPH 30 END-OF-PERIOD ORDINATES, LAG= 3.44 HOURS, CP= 0.62 VOL= 0.86

3.	10.	20.	32.	47.	62.	79.	97.	116.	135.
156.	177.	198.	221.	243.	266.	289.	313.	337.	361.
386.	411.	435.	459.	481.	507.	522.	543.	557.	572.
586.	597.	610.	620.	629.	636.	642.	646.	648.	649.

NOTE: UNIT HYDROGRAPH VOLUME IS SLIGHTLY LESS THAN 1.0 DUE TO COMPUTER PROGRAM LIMITATIONS FOR A RAINFALL DURATION OF 5 MIN. HOWEVER THE 5 MIN. DURATION IS NECESSARY FOR DOWNSTREAM ROUTING DATA & FAILURE CONDITIONS.

SHEET 13 OF 17

649.	640.	641.	634.	622.	607.	591.	576.	562.	547.
533.	520.	507.	494.	481.	469.	457.	445.	434.	423.
412.	402.	391.	382.	372.	362.	353.	344.	335.	327.
319.	313.	303.	295.	287.	280.	273.	266.	259.	253.
246.	240.	234.	228.	222.	216.	211.	206.	200.	195.
190.	185.	181.	176.	172.	167.	163.	159.	155.	151.

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	23.85	21.47	2.39	73426.
										(606.1)	(545.1)	(61.)(	20792.04)

********** *********** ********** ********* **********

HYDROGRAPH ROUTING

ROUTING FOR LOWER ALFORD POND DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.0	0.0	1	1	3	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.0	0.0	-1034.	-1

STAGE	1034.00	1034.50	1035.00	1035.40	1036.10	1036.30	1036.90	1037.60	1038.40	1039.90
	1041.40	1042.90	1044.40							
FLOW	0.0	28.37	91.50	189.60	398.50	446.20	693.60	947.50	1275.70	2022.60
	2876.20	3824.40	4858.60							
SURFACE AREA=	32.	34.	49.	69.						
CAPACITY=	0.	266.	504.	1674.						
ELEVATION=	1026.	1034.	1040.	1060.						

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1034.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1035.6	3.1	1.5	120.

CREST LENGTH AT OR BELOW	0.	69.	90.	112.	117.	124.	128.	135.
ELEVATION	1035.0	1036.0	1036.5	1037.0	1037.5	1038.0	1038.5	1039.0

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
120.	1.00	1023.00	0.50	1034.20	1039.60

WARNING *** TOP OF DAM, BOTTOM OF BREACH, OR LOW-LEVEL OUTLET IS NOT WITHIN RANGE OF GIVEN ELEVATIONS IN STORAGE-ELEVATION DATA
BOTTOM OF RESERVOIR ASSUMED TO BE AT 1026.20
STORAGE-ELEVATION DATA WILL BE EXTRAPOLATED ABOVE ELEVATION 1060.00

BEGIN DAM FAILURE AT 42.50 HOURS

SHEET 14 OF 17

PEAK OUTFLOW IS 13684. AT TIME 43.00 HOURS

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
120.	1.00	1023.00	0.53	1034.20	1045.00

WARNING *** TOP OF DAM, BOTTOM OF BREACH, OR LOW-LEVEL OUTLET IS NOT WITHIN RANGE OF GIVEN ELEVATIONS IN STORAGE-ELEVATION DATA
BOTTOM OF RESERVOIR ASSUMED TO BE AT 1026.20
STORAGE-ELEVATION DATA WILL BE EXTRAPOLATED ABOVE ELEVATION 1060.00

PEAK OUTFLOW IS 4592. AT TIME 43.17 HOURS

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTE TO SECTION 1200 FEET DOWNSTREAM OF DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

WLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.0	0.0	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.0	0.0	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELAVT	ELMAX	RLNTH	SEL
0.0600	0.0400	0.0600	1013.5	1040.0	1200.	0.00490

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.0 1040.00 135.00 1020.00 135.00 1015.00 145.00 1013.50 150.00 1013.50
160.00 1015.00 190.00 1020.00 300.00 1040.00

STORAGE	0.0	0.35	1.78	3.66	6.18	9.34	13.08	17.41	22.31	27.79
	33.84	40.47	47.67	55.45	63.81	72.74	82.25	92.33	102.99	114.22
OUTFLOW	0.0	46.20	251.97	634.36	1216.90	2027.77	3089.69	4415.42	6024.10	7934.51
	10165.00	12733.51	15657.60	18954.41	22640.80	26733.22	31247.84	36200.56	41607.02	47482.56
STAGE	1013.50	1014.39	1016.29	1017.68	1019.08	1020.47	1021.87	1023.26	1024.66	1026.05
	1027.45	1028.34	1030.23	1031.63	1033.02	1034.42	1035.81	1037.21	1038.60	1040.00
FLOW	0.0	46.20	251.97	634.36	1216.90	2027.77	3089.69	4415.42	6024.10	7934.51
	10165.00	12733.51	15657.60	18954.41	22640.80	26733.22	31247.84	36200.56	41607.02	47482.56

MAXIMUM STAGE IS 1029.2

MAXIMUM STAGE IS 1023.4

********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1	RATIOS APPLIED TO FLOWS
				0.50	
HYDROGRAPH AT	1	5.34	1	4655.	
		(13.83)		(131.80)(	
			2	4655.	
				(131.80)(	
ROUTED TO	2	5.34	1	13684.	
		(13.83)		(387.49)(	
			2	4592.	
				(130.04)(	
ROUTED TO	3	5.34	1	13498.	
		(13.83)		(382.22)(	
			2	4592.	
				(130.04)(	

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 *FAILURE*.....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1034.20	1034.00	1035.60
STORAGE	266.	259.	315.
OUTFLOW	9.	0.	249.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.50	1039.62	4.02	486.	13684.	7.65	43.00	42.50

PLAN 2 *NON-FAILURE*...

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1034.20	1034.00	1035.60
STORAGE	266.	259.	315.
OUTFLOW	9.	0.	249.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.50	1039.77	4.17	493.	4592.	12.75	43.17	0.0

PLAN 1 STATION 3 *FAILURE*

STATION 3 IS DAMAGE CENTER

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.50	13498.	1029.2	43.00

PLAN 2 STATION 3 *NON-FAILURE*

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.50	4592.	1023.4	43.25

	NON-FAILURE	FAILURE
FLOW AT DAMAGE CENTER	13,498 CFS.	4592 CFS.
STAGE AT DAMAGE CENTER	1029.2 FT.	1023.4 FT.

DEPTH AT DAMAGE CENTER INCREASES 5.8 FEET
FLOW AT DAMAGE CENTER INCREASES 8,906 CFS.

SHEET 17 OF 17

APPENDIX E

PLATES

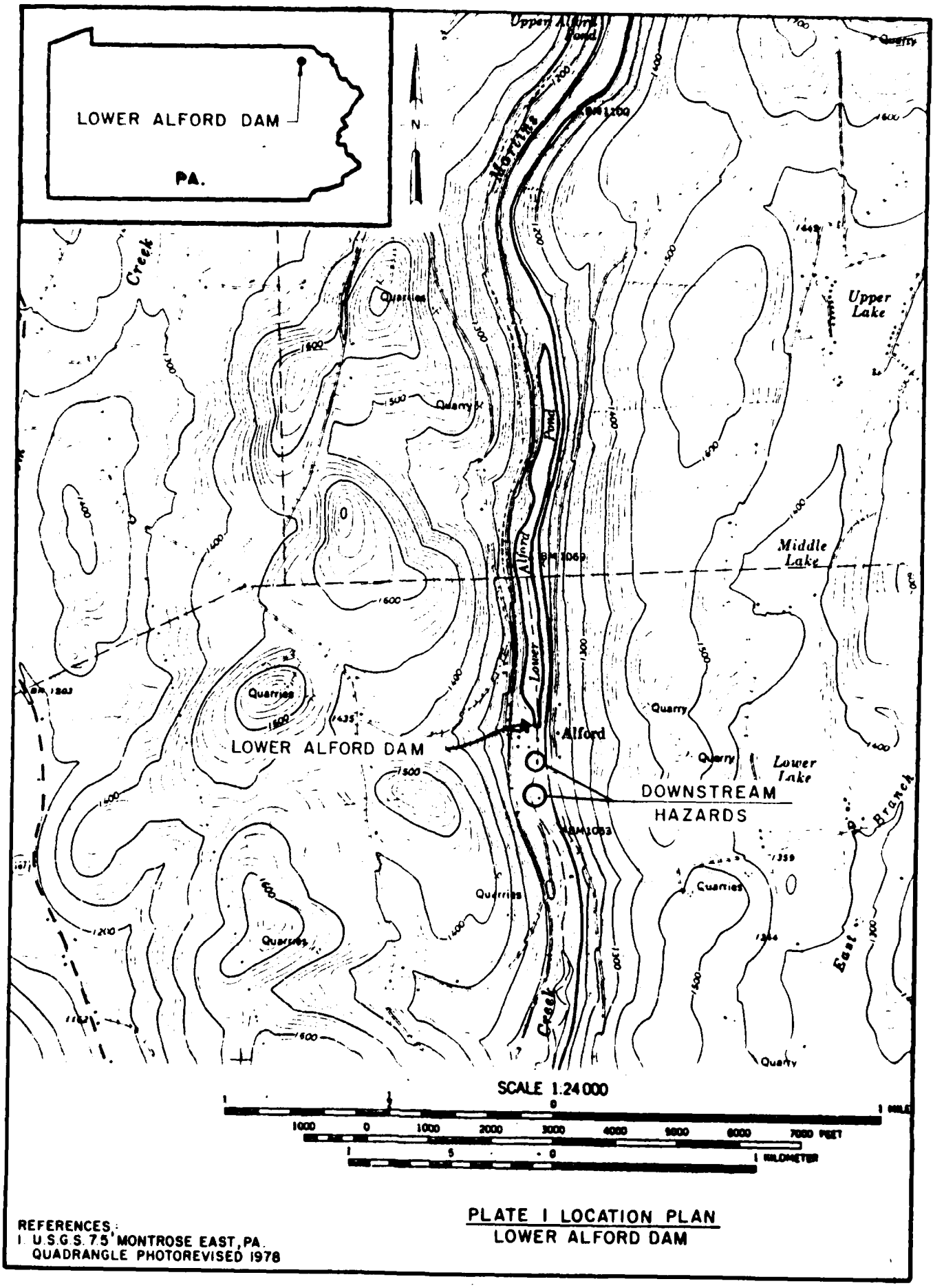
CONTENTS

Plate 1 - Location Plan

Plate 2 - Watershed Map

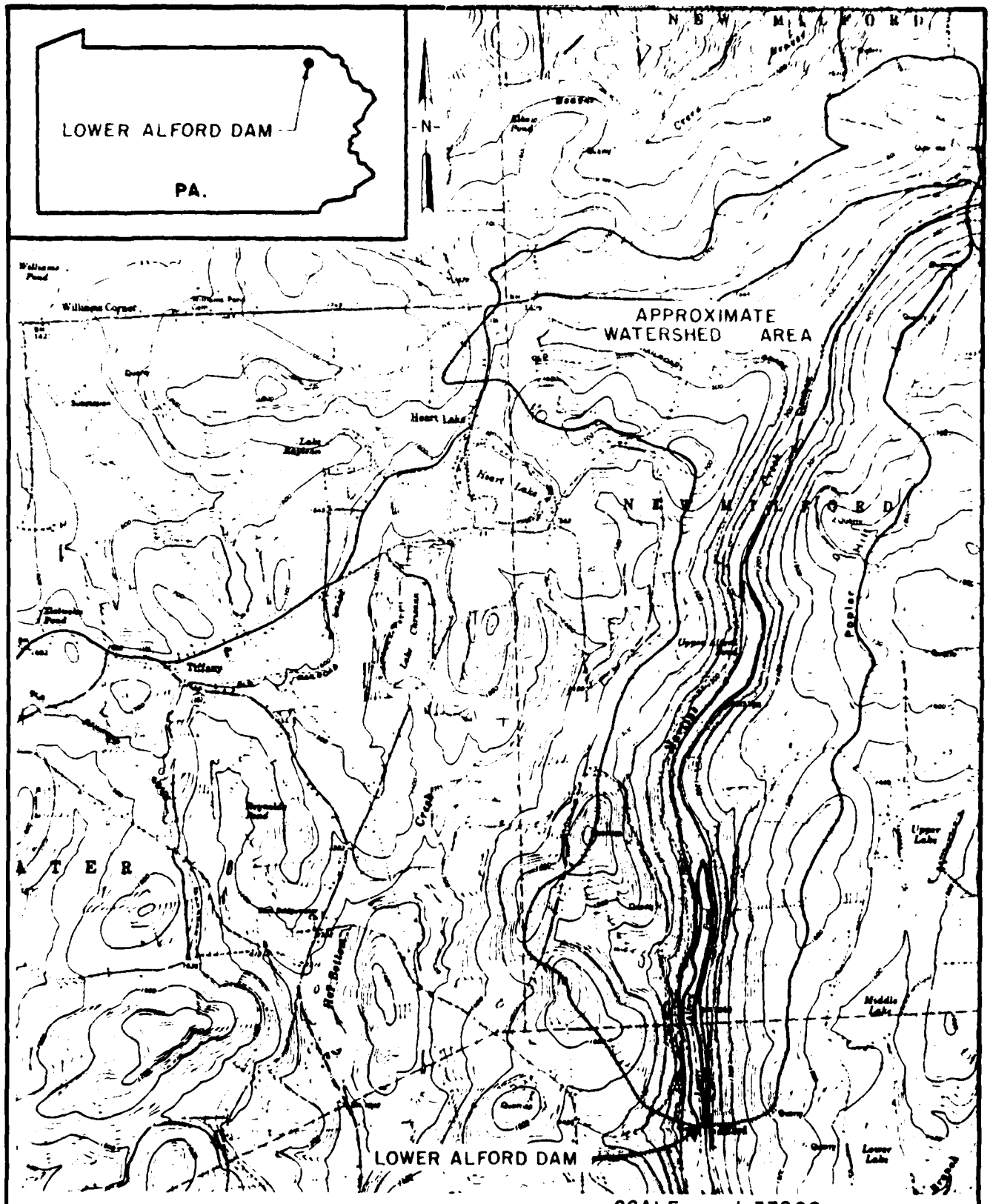
Plate 3 - Field Sketch Plan from Field Inspection

Plate 4 - Top of Dam Profile and Typical Cross Section from Field Inspection



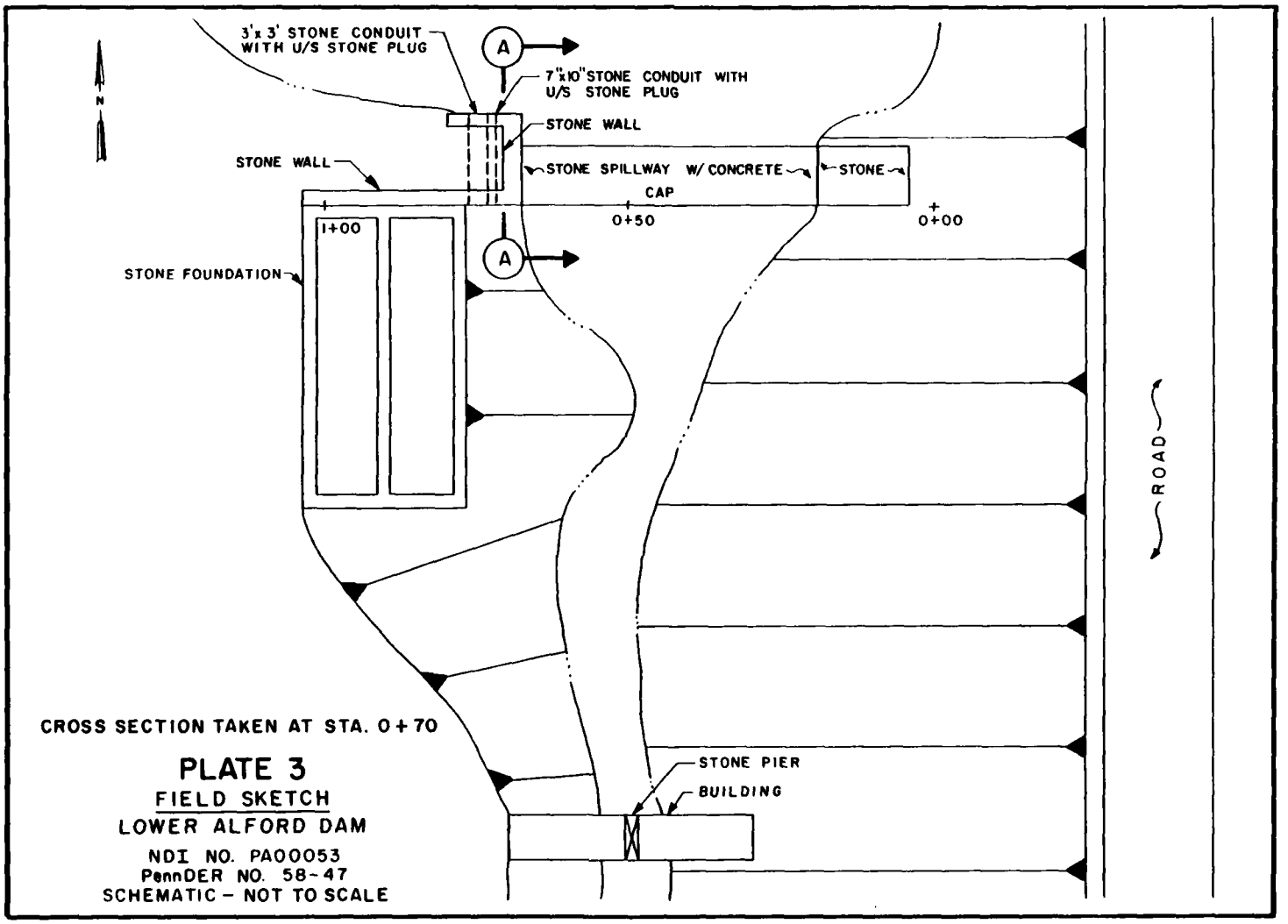
REFERENCES:
1. U.S.G.S. 7.5' MONTROSE EAST, PA. QUADRANGLE PHOTOREVISED 1978

PLATE 1 LOCATION PLAN
LOWER ALFORD DAM



REFERENCES:
1. U.S.G.S. 7.5' MONTROSE EAST, PA QUADRANGLE. PHOTOREVISED 1978
2. U.S.G.S. 7.5' FRANKLIN FORKS, PA. QUADRANGLE. 1968

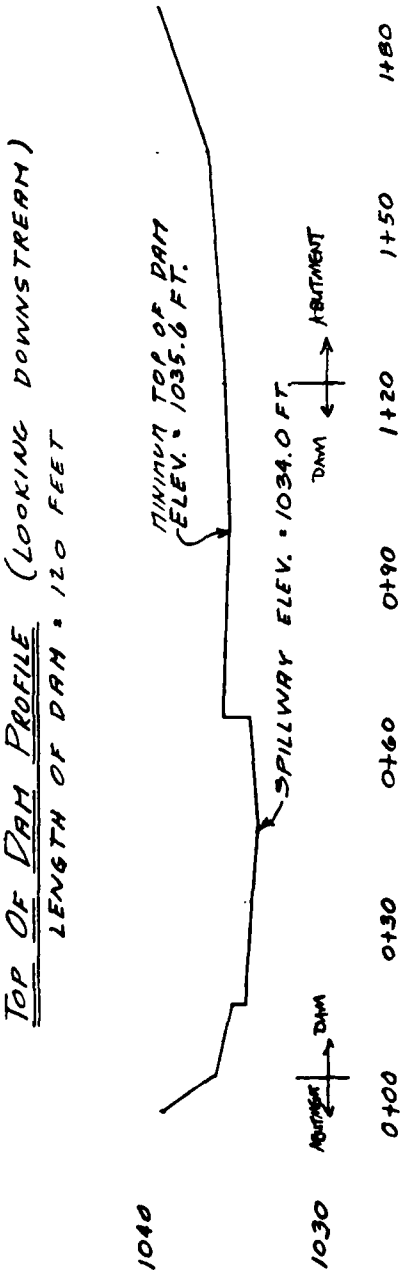
PLATE 2 WATERSHED MAP
LOWER ALFORD DAM


3'x 3' STONE CONDUIT WITH U/S STONE PLUG
A
7"x10" STONE CONDUIT WITH U/S STONE PLUG
STONE WALL
STONE WALL
STONE SPILLWAY W/ CONCRETE CAP
STONE
1+00
0+50
0+00
A
STONE FOUNDATION
ROAD
STONE PIER
BUILDING
N
CROSS SECTION TAKEN AT STA. 0+70
PLATE 3
FIELD SKETCH
LOWER ALFORD DAM
NDI NO. PA00053
PennDER NO. 58-47
SCHEMATIC - NOT TO SCALE

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject LOWER ALFORD DAM S.O. No. 13837-00-AAA-06
TOP OF DAM PROFILE Sheet No. 4 of 17
TYPICAL CROSS SECTION Drawing No.
Computed by GWT Checked by WDL Date 11-17-80



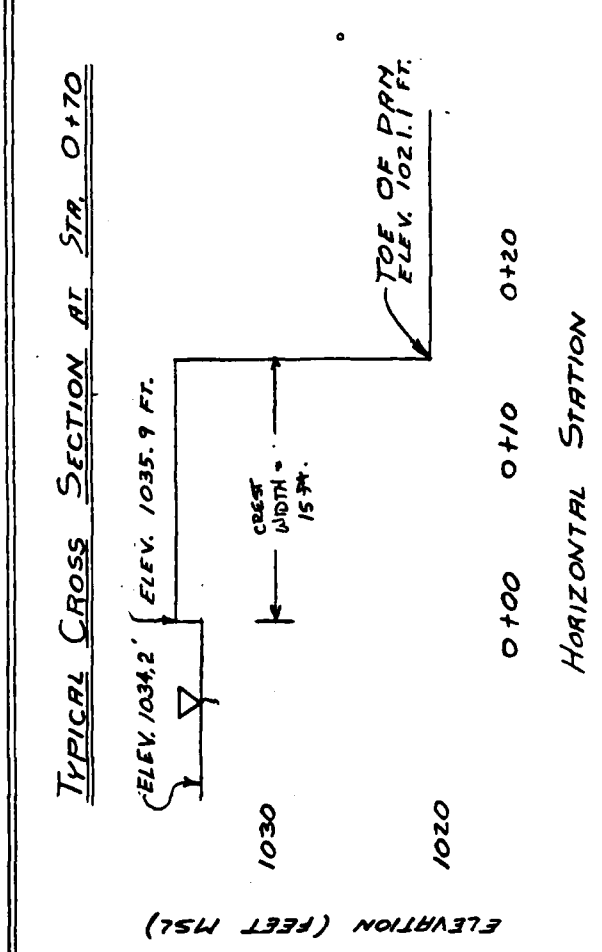


PLATE 4

APPENDIX F

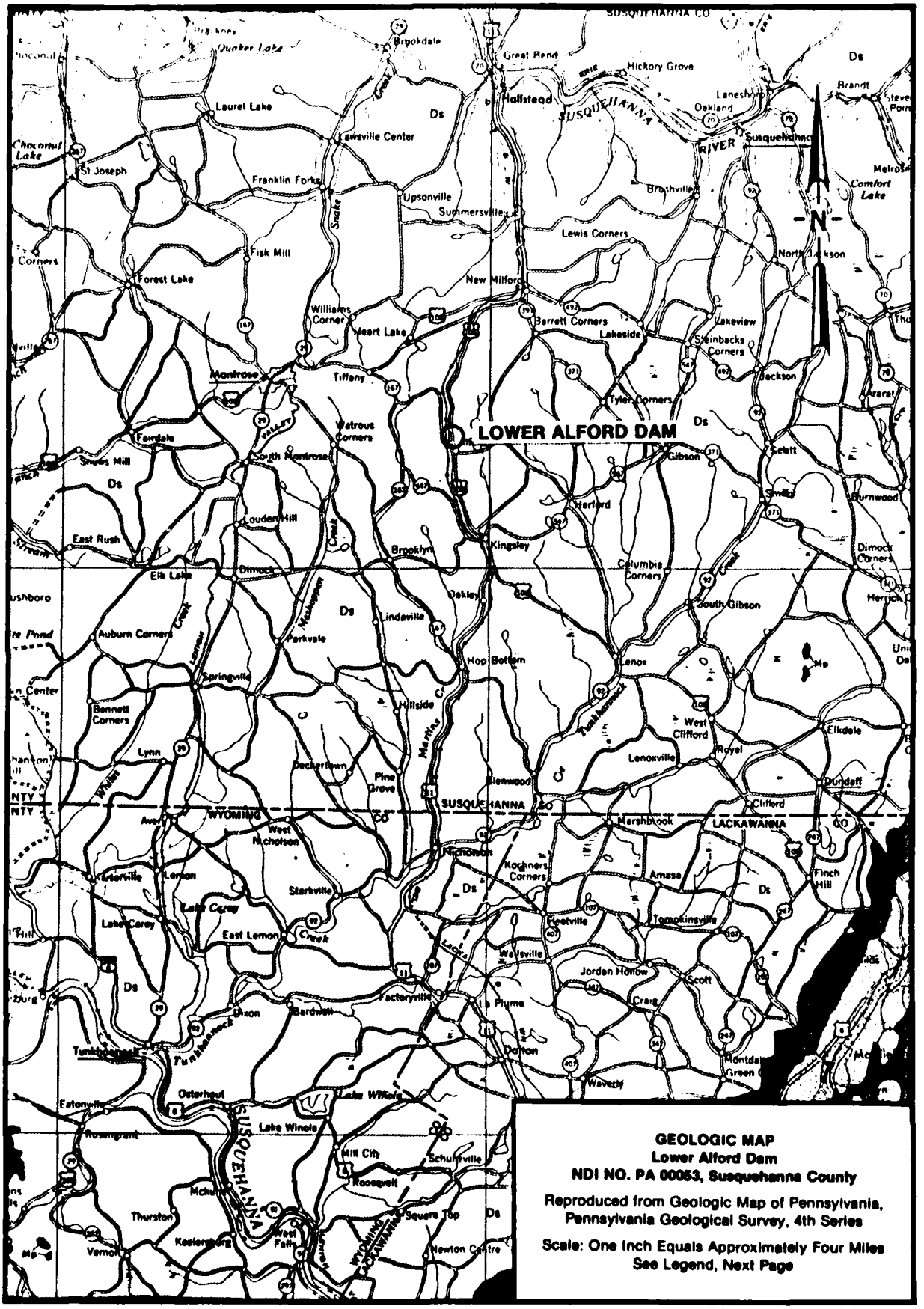
REGIONAL GEOLOGY

LOWER ALFORD DAM
NDI No. PA 00053, PennDER No. 58-47

REGIONAL GEOLOGY

Lower Alford Dam is located in the Glaciated Low Plateaus physiographic province. The area has been glaciated at least three times and is presently covered with Wisconsin Stage deposits. The land drains to the south and has a maximum relief of approximately 500 feet. According to the Soil Conservation Service's Soil Survey for Susquehanna County, the surface soils in the vicinity of the dam consist primarily of silt loams on the valley floor and very stoney, silt loams on the valley walls. All soils are of the Mardin-Volusia-Oquaga association. No test boring data were available for review, thus, the thickness of this overburden is difficult to ascertain.

Geologic references indicate that the bedrock in the vicinity of the dam consists of members of the Catskill Formation in the Susquehanna Group. The Catskill Formation contains red and gray shales and sandstones of Upper Devonian age. The formation may also contain scattered, thin, streaks of coal and scattered fish remains. The strata near Lower Alford Pond were deposited in a bay or delta front environment and remain essentially horizontal after the Appalachian Uplift.



GEOLOGIC MAP
Lower Alford Dam
NDI NO. PA 00053, Susquehanna County

Reproduced from Geologic Map of Pennsylvania, Pennsylvania Geological Survey, 4th Series

Scale: One Inch Equals Approximately Four Miles
See Legend, Next Page

GEOLOGY MAP LEGEND

DEVONIAN

UPPER

WESTERN PENNSYLVANIA

Oswayo Formation
Greenish gray to gray shales, siltstones and sandstones becoming increasingly shaly westward, considered equivalent to type Oswayo, Ricetville Formation Dr in Erie and Crawford Counties, probably not distinguishable north of Corry.

Dcr

Cattaraugus Formation
Red, gray and brown shale and sandstone with the proportion of red decreasing westward, includes Venango sands of drillers and Salamanca sandstone and conglomerate, some limestone in Crawford and Erie counties.

Conneaut Group
Alternating gray, brown, greenish and purplish shales and siltstones; includes "pink rock" of drillers and "Chemung" and "Girard" Formations of northwestern Pennsylvania.

Dcn

Canadaway Formation
Alternating brown shales and sandstones; includes "Portage" Formation of northwestern Pennsylvania.

CENTRAL AND EASTERN PENNSYLVANIA

Oswayo Formation
Brownish and greenish gray, fine and medium grained sandstones with some shales and scattered calcareous lenses, includes red shales which become more numerous eastward. Relation to type Oswayo not proved.

Dck

Catskill Formation
Chiefly red to brownish shales and sandstones, includes gray and greenish sandstone tongues named Elk Mountain, Honesdale, Shohola, and Delaware River in the east.

Dm

Marine beds
Gray to olive brown shales, graywackes, and sandstones, contains "Chemung" beds and "Portage" beds including Burket, Brallier, Harrell, and Trimmers Rock, Tully Limestone at base.

Ds

Susquehanna Group
Barbed line is "Chemung-Catskill" contact of Second Pennsylvania Survey County reports, barbs on "Chemung" side of line.

MIDDLE AND LOWER

Dh

Hamilton Group

Mahantango Formation
Brown to olive shale with interbedded sandstones which are dominant in places (Montebello); highly fossiliferous in upper part; contains "Centerfield coral bed" in eastern Pennsylvania.

Marcellus Formation
Black, fissile, carbonaceous shale with thick, brown sandstone (Turkey Ridge) in parts of central Pennsylvania.

Onondaga Formation
Greenish blue, thin bedded shale and dark blue to black, medium bedded limestone with shale predominant in most places; includes Selinsgrove Limestone and Needmore Shale in central Pennsylvania and Buttermilk Falls Limestone and Esopus Shale in easternmost Pennsylvania; in Lehigh Gap area includes Palmerton Sandstone and Bowmanstown Chert.

Dms

Oriskany Formation
White to brown, fine to coarse grained, partly calcareous, locally conglomeratic, fossiliferous sandstone (Ridgeley) at the top; dark gray, cherty limestone with some interbedded shales and sandstones below (Shriver).

Helderberg Formation
Dark gray, calcareous, thin bedded shale (Mandata) at the top, equivalent to Port Ewen Shale and Becraft Limestone in the east, dark gray, cherty, thin bedded, fossiliferous limestone (New Scotland) with some local sandstones in the middle; and, at the base dark gray, medium to thick bedded, crystalline limestone (Coeymans), sandy and shaly in places with some chert nodules.

END

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